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July 11, 2006

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Chief, Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
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Re: DOJ No. 90-5-2-1-08203

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Harrish Narayen
Illinois Environmental Protection Agency, Bureau of Air
9511 West Harrison Street
Des Plaines, IL 60016

Re: USEPA NOV/FOV No. EPA-5-03-IL-02
USA v. A. Finkl & Sons Co. (Unfiled); Draft Consent Decree - Test Protocol

Ladies and Gentlemen:

Following our letter of May 26, 2006, enclosed please find a revised final protocol (dated July 7, 2006) prepared by Clean Air Engineering for your review and approval. We will be happy to discuss this revised protocol and address any questions you may have. Your prompt attention to this matter would be greatly appreciated. Thank you for your attention.

Sincerely,

James T. Harrington

JTH:drm
Enclosure
Cc: B. Liimatainen (w/o encls.)
J. Curci (w/o encls.)
J. Guliana (w/encls.)
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REVISION HISTORY

PROTOCOL FOR PARTICULATE TESTING

Revision History

Revision No:	Date	Pages	Comments
0	05/17/06	All	Original version of document.
1	7/7/06	All	Changes based on discussions with regulators.

CONTENTS

PROJECT OVERVIEW

A. Finkl & Sons Co. (Finkl) contracted Clean Air Engineering (CleanAir) to perform particulate testing at their facility located in Chicago, IL for compliance purposes.

The test parameters included the following pollutants:

- total suspended particulate (TSP)
- opacity

The testing is tentatively scheduled to take place at the outlets of the three baghouses during the week of August 7, 2006. Coordinating the field testing will be:

John Guliana	Mark Roach, P.E.
A. Finkl & Sons Co.	Clean Air Engineering
2011 N. Southport Ave.	500 W. Wood St.
Chicago, IL 60614-4079	Palatine, IL 60067-4929
johng@finkl.com	mroach@cleanair.com

The facility is covered under 40 CFR 60.subpart AAa – Standard of Performance for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels Constructed After August 17, 1983. The standard for particulate matter exiting from a control device is restricted to 0.0052 grains/dscf or less.

Table 1-1 outlines the tentative test schedule for the test program. Two of the baghouses are positive pressure style and are identical in design. The third baghouse is the typical negative pressure design. The two positive pressure baghouses are designated East/North and West respectively. The negative pressure design baghouse is designated East/South (E/S). The names of each baghouse will be reported as follows:

- East/North positive pressure baghouse — East baghouse
- West positive pressure baghouse — West baghouse
- East/South negative pressure baghouse — New baghouse

DISCUSSION OF TEST PROGRAM

The facility can operate any combination of baghouses. Two baghouses typically run during operations. Two sampling scenarios are proposed for this program. The first scenario is to operate and sample the two positive pressure baghouses simultaneously. The second scenario is to operate and sample one of the positive pressure baghouse and the negative pressure baghouse simultaneously.

The facility begins operating the two electric arc furnaces around 18:00. The furnaces are alternately charged during the overnight hours when electrical demand is low. Operations typically conclude at 10:30 the next morning. Subpart AAa requires a 4 hour particulate run time. The extended run times allow measurement of particulate during the complete heat cycle. Therefore, sampling will take place during the overnight hours.

PROJECT OVERVIEW

Opacity readings are required in accordance with the procedures of §60.11. The minimum total time of observation required is 3 hours (30 6-minute) readings. The opacity readings can only be performed during the early evening and morning hours when daylight is available. It is anticipated that opacity will be read during the first 1½ to 2 hours. A total of three hours of opacity will be performed during each scenario.

There will be a total of three opacity readers. Two will read opacity on each of the operating baghouses and one will read opacity of the furnace building. Opacity readings will be performed by Finkl's certified opacity readers and CleanAir personnel.

Table 1-1:
Proposed Schedule of Activities

Day	Activity	Location	Test Method	Replicates	Sample Time
1	Mobilization				
	Set-up on East & West Baghouses				
2	East BH				
	Particulate Matter	Outlet(s)	4, 5D	2	240 min.
	Flow[1]	Inlet	2	2	
	Opacity	Outlet	9	2	60 min
	West BH				
	Particulate Matter	Outlet(s)	4, 5D	2	240 min.
	Flow[1]	Inlet	2	2	
	Opacity	Outlet	9	2	
	Opacity	Furnace building	9	2	60 min
3	East BH				
	Particulate Matter	Outlet(s)	4, 5D	1	240 min.
	Flow[1]	Inlet	2	1	
	Opacity	Outlet	9	1	60 min
	West BH				
	Particulate Matter	Outlet(s)	4, 5D	1	240 min
	Flow[1]	Inlet	2	1	
	Opacity	Outlet	9	1	60 min.
	Opacity	Furnace building	9	1	60 min
	Set up on New BH				
4	East BH[2]				
	Particulate Matter	Outlet(s)	4, 5D	2	240 min
	Flow[1]	Inlet	2	2	60 min.
	Opacity	Outlet	9	2	
	New BH				
	Particulate Matter	Outlet(s)	1-5	2	240 min
	Opacity	Outlet	9	2	60 min.
	Opacity[3]	Furnace building	9	2	60 min

Table 1-2: continued

Day	Activity	Location	Test Method	Replicates	Sample Time
5	East BH				
	Particulate Matter	Outlet(s)	4, 5D	1	240 min.
	Flow[1]	Inlet	2	1	60 min
	Opacity	Outlet	9	1	
	New BH				
	Particulate Matter	Outlet(s)	1-5	1	240 min.
	Opacity	Outlet	9	1	60 min
	Opacity[3]	Furnace building	9	1	60 min
	Demobilization				

[1] Flow measurements will be made along the inlet duct to the positive pressure baghouses. Flow measurement for the negative pressure baghouse will be made at the outlet.
[2] During second sampling scenario either the East BH or West BH will be sampled.
[3] Opacity reading of the building may not be necessary during the second testing sceanario if there is no change in collection.

The negative pressure baghouse will be sampled in accordance with EPA Method 5. The two positive pressure baghouses will be sampled in accordance with EPA Method 5D using Method 17.

Both positive pressure baghouses, East and West have 5 compartments each consisting of two sections. Each section has its own vent and is evenly divided with a set number of bags exiting from the vent. Sampling will be conducted above the bags at the outlet. Therefore, each section will be sampled individually

The requirements of Method 5D are addressed as follows:

1. "All compartments (sections) must be sampled during the test."
   - All ten sections will be sampled during the test program.
2. "The same number of sections must be sampled during each run."
   - Four sections will be sampled during each run
3. "Minimum number of sample points per run: 24."
   - Each section will have 3 sample ports.
   - Four points will be sampled per port for a total of 48 points per run.
4. "Minimum number of sample points per test: 72."
   - Forty eight sample points will be sampled per run.
   - Over the test, 3 sample runs at total of 144 points will be sampled.
5. "Minimum number of sample points per section: 8."
   - Each section will have 12 sample points.

PROJECT OVERVIEW

The velocities of exhaust gases from the two positive pressure baghouses are too low to measure accurately with the Type S pitot tube. Flow measurements will be taken along the inlet duct to the positive pressure baghouses. The measured inlet velocity will be used in calculating the flow at each point and through each section. Flow measurement for the negative pressure baghouse will be made at the outlet.

During sampling the following information will be recorded in accordance with §60.276a(f):

- charge weights and materials and tap weights and materials;
- heat times, including start and stop times , and a log of process operation, including periods of no operation during; and
- control device operation log.

A presentation of the proposed test results tables is provided in the Section 2.

RESULTS

Table 2-1:
East Baghouse Outlet, Particulate Results

Run No.		1	2	3	Average
Date (2006)					
Start Time (approx.)					
Stop Time (approx.)					
Gas Conditions					
O_2	Oxygen (dry volume %)				
CO_2	Carbon dioxide (dry volume %)				
T_s	Sample temperature (°F)				
B_w	Actual water vapor in gas (% by volume)				
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)				
Q_s	Volumetric flow rate, standard (scfm)				
Q_{std}	Volumetric flow rate, dry standard (dscfm)				
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)				
Laboratory Data					
m_n	Net matter collected (g)				
Particulate Results					
C_{sd}	Particulate Concentration (lb/dscf)				
C_a	Particulate Concentration (lb/acf)				
C_{sd}	Particulate Concentration (gr/dscf)				
$E_{lb/hr}$	Particulate Rate (lb/hr)				

DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Finkl manufactures forging die steel, plastic mold steels, die casting steels & custom open-die forgings. The facility operates two 90 ton electric arc furnaces. The furnaces are covered with a canopy hood that collects emissions during the process. The hoods then directs the flue gas though a combination of baghouses. The emissions from the ingot surface preparation and cleaning of steel forging processes are vented to the baghouses, also.

The entire heat from the beginning of charging to end of tapping is approximately 4.5 to 5 hours. The charging phase will include two or three scrap loadings. The refining phase takes approximately 30 to 60 minutes. Tapping time is 5 to 10 minutes. The furnaces start times are staggered by approximately 30 minutes.

Each positive pressure baghouse is equipped with a pulse jet air cleaning system. Each baghouse has five compartments. Each compartment is divided into two equal sections with each section having separate vents. A compartment is off line during cleaning which last for 3 minutes. There is a 90 second idle time before cleaning begins on the next compartment. If during sampling of a section the cleaning cycle begins sampling will be temporarily stopped until cleaning is complete and the flow through the compartment is restored. The entire cleaning cycle for a baghouse takes approximately 25 minutes. Each section will be sampled for a total of 60 minutes. Therefore, while sampling, each section will be off line twice.

Testing will be performed at the following locations:

- East Baghouse – Inlet
- East Baghouse – Outlet
- West Baghouse – Inlet
- West Baghouse - Outlet
- New Baghouse – Outlet

DESCRIPTION OF INSTALLATION

DESCRIPTION OF SAMPLING LOCATION(S)

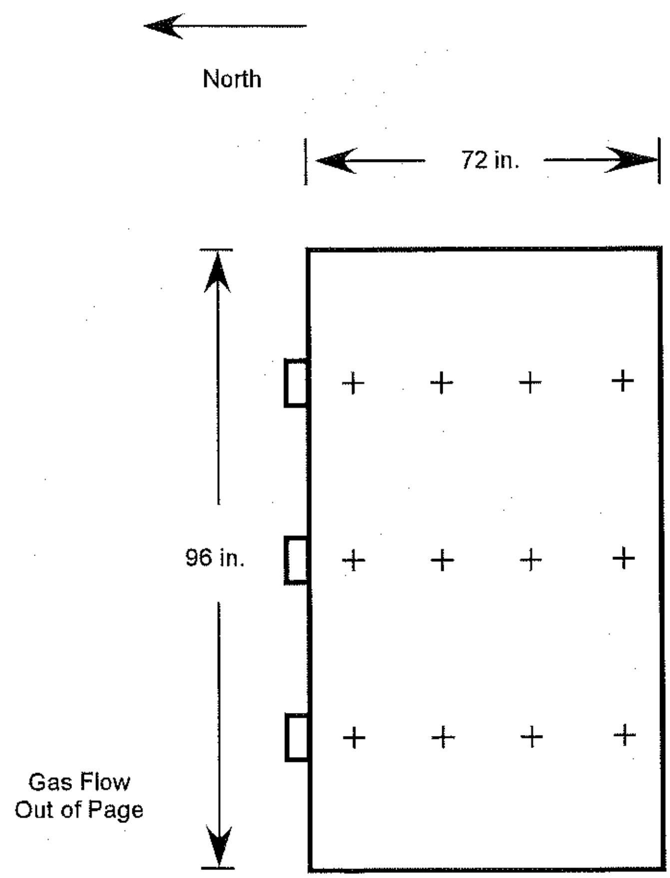
Sampling point locations will determined according to EPA Method 1.
Table 3-1 outlines the planned sampling point configurations. Any variation or field changes to the planned configuration will be documented and provided in the final report. Figure 3-1 through 3-3 illustrate(s) the proposed sampling points and orientation of sampling ports for each of the sources tested in the program.

Table 3-1:
Sampling Points

Location	Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
East BH Inlet	Flow	2	1-3	2	12	NA	NA	3-1
East BH Outlet[1]	Particulate	5D	1-3	12	4	5	240	3-2
West BH Inlet	Flow	2	1-3	2	12	NA	NA	3-1
West BH Outlet[1]	Particulate	5D	1-3	12	4	5	240	3-2
New BH Outlet	Particulate	1-5	1-3	2	12	10	240	3-3

[1] The four outlet sections will be sampled per run on the East and West baghouses Each comparment will have 3 sample ports. Four points will be sampled per port.

DESCRIPTION OF INSTALLATION



+ Indicates sampling point

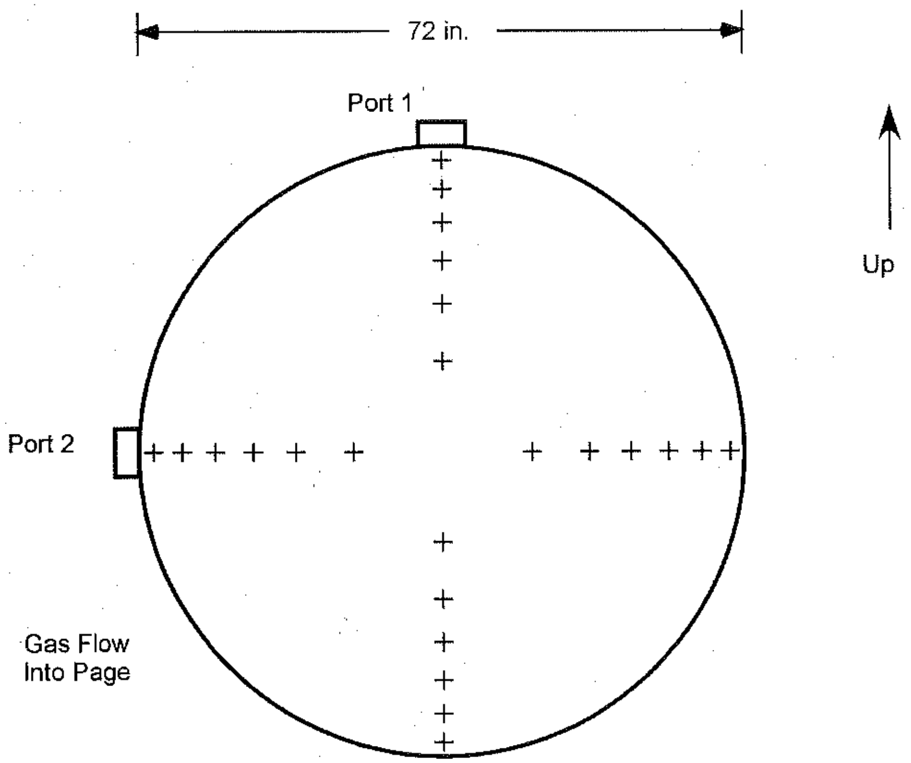
Sampling Point	Port to Point Distance (in.)
1	84
2	60
3	36
4	12

Equivalent Duct diameters upstream from flow disturbance (A):	NA	Limit: 0.5
Equivalent Duct diameters downstream from flow disturbance (B):	NA	Limit: 2.0

Figure 3-1: East and West Baghouse Outlet Sampling Point Determination (EPA Method 1)

DESCRIPTION OF INSTALLATION

DESCRIPTION OF SAMPLING LOCATION (CONTINUED)



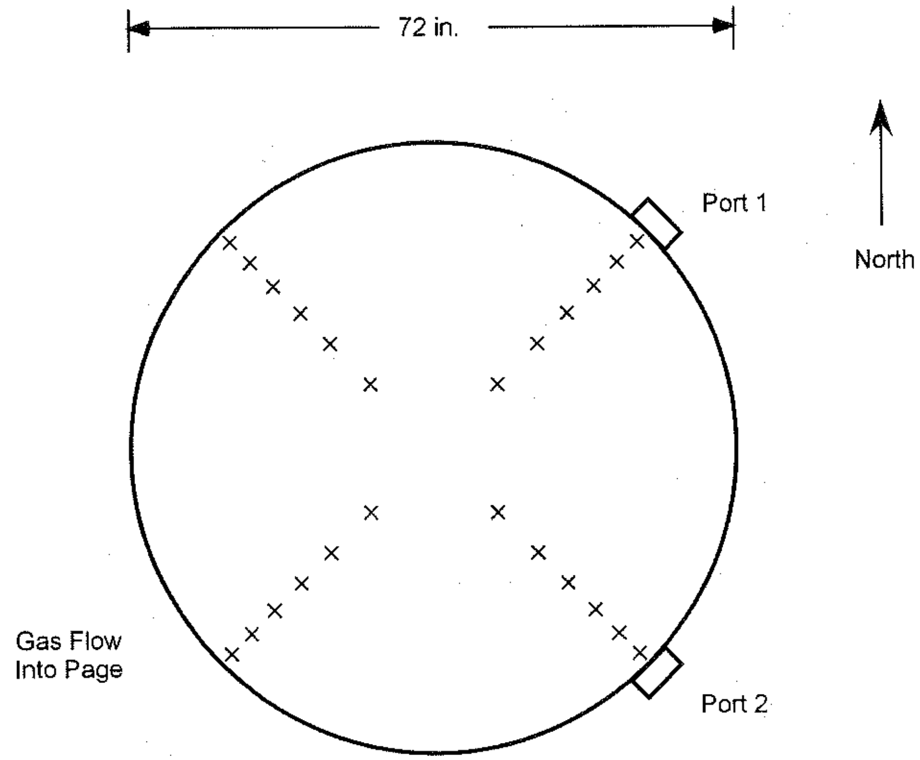
Traverse Point	Port to Point Distance (in.)
1	70.5
2	67.2
3	63.5
4	59.2
5	54
6	46.4
7	25.6
8	18.0
9	12.8
10	8.5
11	4.8
12	1.5

Duct diameters upstream from flow disturbance (A):	TBD[1]	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	TBD[1]	Limit: 2.0

1. Sampling ports have yet to be installed. Maximum number of traverse points assumed.

Figure 3-2: East and West Baghouse Inlet Traverse Point Determination (EPA Method 1)

DESCRIPTION OF INSTALLATION



Sampling Point	Port to Point Distance (in.)
1	70.5
2	67.2
3	63.5
4	59.2
5	54
6	46.4
7	25.6
8	18.0
9	12.8
10	8.5
11	4.8
12	1.5

Duct diameters upstream from flow disturbance (A):	TBD[1]	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	TBD[1]	Limit: 2.0

1. Sampling ports have yet to be installed. Maximum number of sample points assumed.

Figure 3-3: New Baghouse Sampling Point Determination (EPA Method 1)

METHODOLOGY

Clean Air Engineering will follow procedures as detailed in U.S. Environmental Protection Agency (EPA) Methods 1, 2, 3, 4, 5D and 17. The following table summarizes the methods and their respective sources.

Table 4-1:
Summary of Sampling Procedures

Title 40 CFR Part 60 Appendix A	
Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 3	"Gas Analysis for the Determination of Dry Molecular Weight"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 5D	"Determination of Particulate Matter Emissions from Positive Pressure Fabric Filters"
Method 17	"Determination of Particulate Matter Emissions from Stationary Sources"

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR) and on the World Wide Web at http://www.cleanair.com.

Diagrams of the sampling apparatus and major specifications of the sampling, recovery and analytical procedures are summarized for each method in Appendix A.

Clean Air Engineering will follow specific quality assurance and quality control (QA/QC) procedures as outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods", EPA/600/R-94/038C. Additional QA/QC methods as prescribed in Clean Air's internal Quality Manual will also be followed. Results of all QA/QC activities performed by Clean Air Engineering are summarized in the test report.

A. FINKL & SONS CO.
CHICAGO, IL

Client Reference No: EAF Sampling
CleanAir Project No: 9939

APPENDIX

TEST METHOD SPECIFICATIONS

A

Specification Sheet for EPA Method 5

Source Location Name(s)	E/S Baghouse Outlet
Pollutant(s) to be Determined	Particulate Matter (PM)
Other Parameters to be Determined from Train	Gas Density, Moisture, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	240 minutes
No. of Sample Traverse Points	N/A	24
Sample Time per Point	N/A	10 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Stainless Steel or Glass	Borosilicate Glass
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Borosilicate or Quartz Glass	Borosilicate Glass
Effective Probe Length	N/A	24 in
Probe Temperature Set-Point	248°F±25°F	248°F±25°F
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.84
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	After Probe	Exit of Probe
Filter Holder Material	Borosilicate Glass	Borosilicate Glass
Filter Support Material	Glass Frit	Teflon
Cyclone Material	N/A	None
Filter Heater Set-Point	248°F±25°F	248°F±25°F
Filter Material	Glass Fiber	Glass Fiber
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

Specification Sheet for EPA Method 5

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Ground Glass or Equivalent	Screw Joint with Silicone Gasket
Connection to Probe or Filter by	Direct Glass Connection	Direct Glass Connection
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 2	Greenburg-Smith	Greenburg-Smith
Impinger 3	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 4	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 5		
Impinger 6		
Impinger 7		
Impinger 8		
Gas Density Determination		
Sample Collection	Multi-point integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Vinyl Bag
Sample Analysis	Orsat or Fyrite Analyzer	Orsat
Sample Recovery Information		
Probe Brush Material	Nylon Bristle	Nylon Bristle
Probe Rinse Reagent	Acetone	Acetone
Probe Rinse Wash Bottle Material	Glass or Polyethylene	Teflon
Probe Rinse Storage Container	Glass or Polyethylene	Glass
Filter Recovered?	Yes	Yes
Filter Storage Container	N/A	Polystyrene
Impinger Contents Recovered?	Provision	N/A
Impinger Rinse Reagent	Deionized Distilled Water	N/A
Impinger Wash Bottle	Glass or Polyethylene	N/A
Impinger Storage Container	Glass or Polyethylene	N/A
Analytical Information		
Method 4 H_2O Determination by	Volumetric or Gravimetric	Gravimetric and Volumetric
Filter Preparation Conditions	Dessicate 24 hours minimum at ambient temperature	Dessicate 24 hours minimum at ambient temperature
Front-Half Rinse Preparation	Evaporate at ambient temperature and pressure	Evaporate at ambient temperature and pressure
Back-Half Analysis	N/A	N/A
Additional Analysis	N/A	None

Specification Sheet for EPA Method 5D

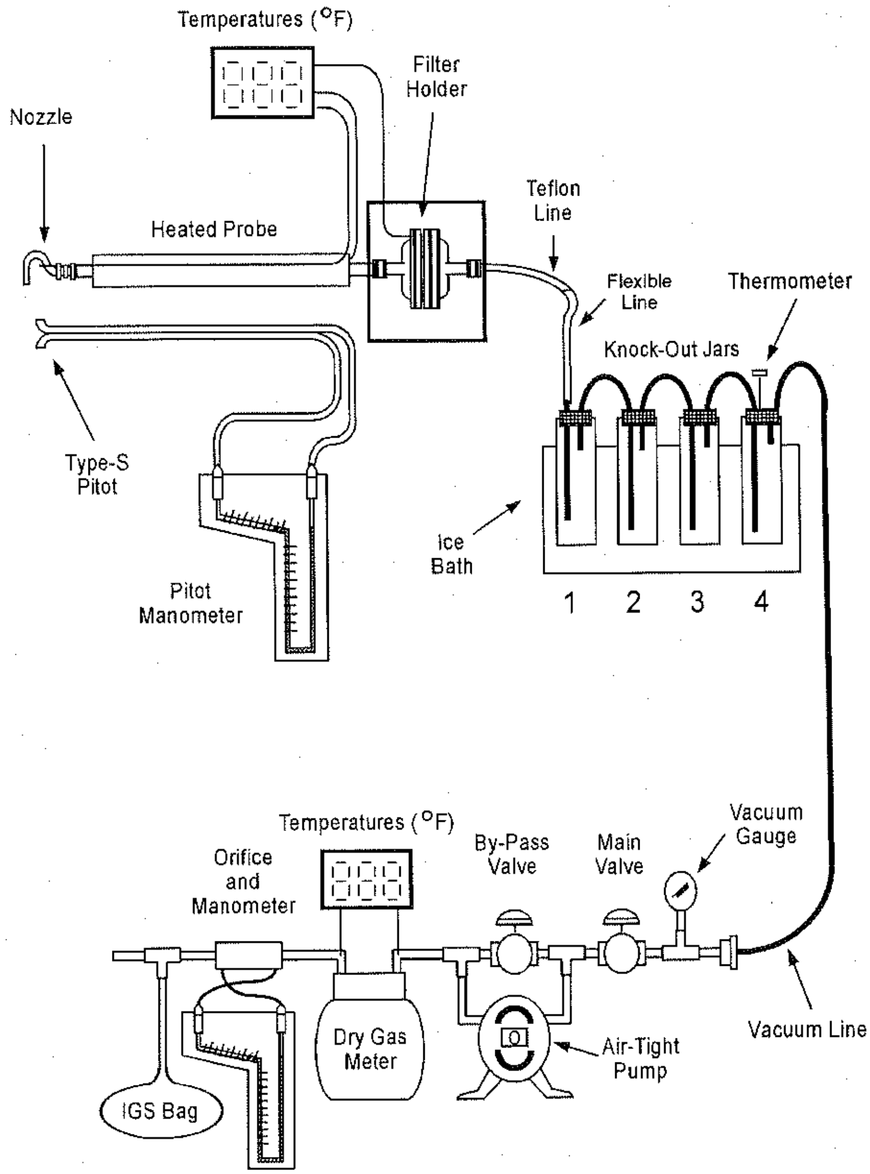
Source Location Name(s)	E/N & W Baghouse Outlet
Pollutant(s) to be Determined	Particulate Matter (PM)
Other Parameters to be Determined from Train	Gas Density, Moisture

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	240 minutes
No. of Sample Traverse Points	N/A	24
Sample Time per Point	N/A	10 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Stainless Steel or Glass	Borosilicate Glass
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Borosilicate or Quartz Glass	Borosilicate Glass
Effective Probe Length	N/A	8 feet
Probe Temperature Set-Point	248°F±25°F	248°F±25°F
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.84
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Separate Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	After Probe	Exit of Probe
Filter Holder Material	Borosilicate Glass	Borosilicate Glass
Filter Support Material	Glass Frit	Teflon
Cyclone Material	N/A	None
Filter Heater Set-Point	248°F±25°F	248°F±25°F
Filter Material	Glass Fiber	Glass Fiber
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

Specification Sheet for EPA Method 5D

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Ground Glass or Equivalent	Screw Joint with Silicone Gasket
Connection to Probe or Filter by	Direct Glass Connection	Direct Glass Connection
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 2	Greenburg-Smith	Greenburg-Smith
Impinger 3	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 4	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 5		
Impinger 6		
Impinger 7		
Impinger 8		
Gas Density Determination		
Sample Collection	Multi-point integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Vinyl Bag
Sample Analysis	Orsat or Fyrite Analyzer	Orsat
Sample Recovery Information		
Probe Brush Material	Nylon Bristle	Nylon Bristle
Probe Rinse Reagent	Acetone	Acetone
Probe Rinse Wash Bottle Material	Glass or Polyethylene	Teflon
Probe Rinse Storage Container	Glass or Polyethylene	Glass
Filter Recovered?	Yes	Yes
Filter Storage Container	N/A	Polystyrene
Impinger Contents Recovered?	Provision	N/A
Impinger Rinse Reagent	Deionized Distilled Water	N/A
Impinger Wash Bottle	Glass or Polyethylene	N/A
Impinger Storage Container	Glass or Polyethylene	N/A
Analytical Information		
Method 4 H_2O Determination by	Volumetric or Gravimetric	Gravimetric and Volumetric
Filter Preparation Conditions	Dessicate 24 hours minimum at ambient temperature	Dessicate 24 hours minimum at ambient temperature
Front-Half Rinse Preparation	Evaporate at ambient temperature and pressure	Evaporate at ambient temperature and pressure
Back-Half Analysis	N/A	N/A
Additional Analysis	N/A	None

EPA Method 5
Sampling Train Configuration



<u>Knock Out Jar Contents</u>

Knock Out Jar 1	100 mL $H_2$0
Knock Out Jar 2	100 mL $H_2$0
Knock Out Jar 3	Empty
Knock Out Jar 4	Silica Gel

EPA Method 5
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)

Container 1
Fiberglass Filter
Petri Dish

1. Remove with tweezers to original container. Brush any loose particulate or filter fibers into sample container
2. If necessary fold in half and place into container
3. Visual Inspection

Container 2
Front Half (FH) Rinse
250 ml Glass

1. **Probe liner, nozzle, cyclone or cyclone bypass and filter FH**
2. Brush/rinse 3X with acetone (6X for metal components)
3. Visual Inspection
4. Label container and measure volume by weight

Container 3
Silica Gel

1. Measure volume by weight, note any color change
2. Recycle silica gel

Container 4*
Back Half (BH) Rinse
500 ml Plastic

1. **BH filter housing, Z-piece, impingers 1, 2, 3 and U-Bends**
2. Measure volume by weight
3. Empty contents into labeled container
4. Rinse with water
5. Visual Inspection
6. Label container and measure volume by weight

Blanks

Container 5
Filter Blank
Plastic Petri Dish

- Clean, unused tared filter

Container 6
Acetone Blank
250 ml Glass

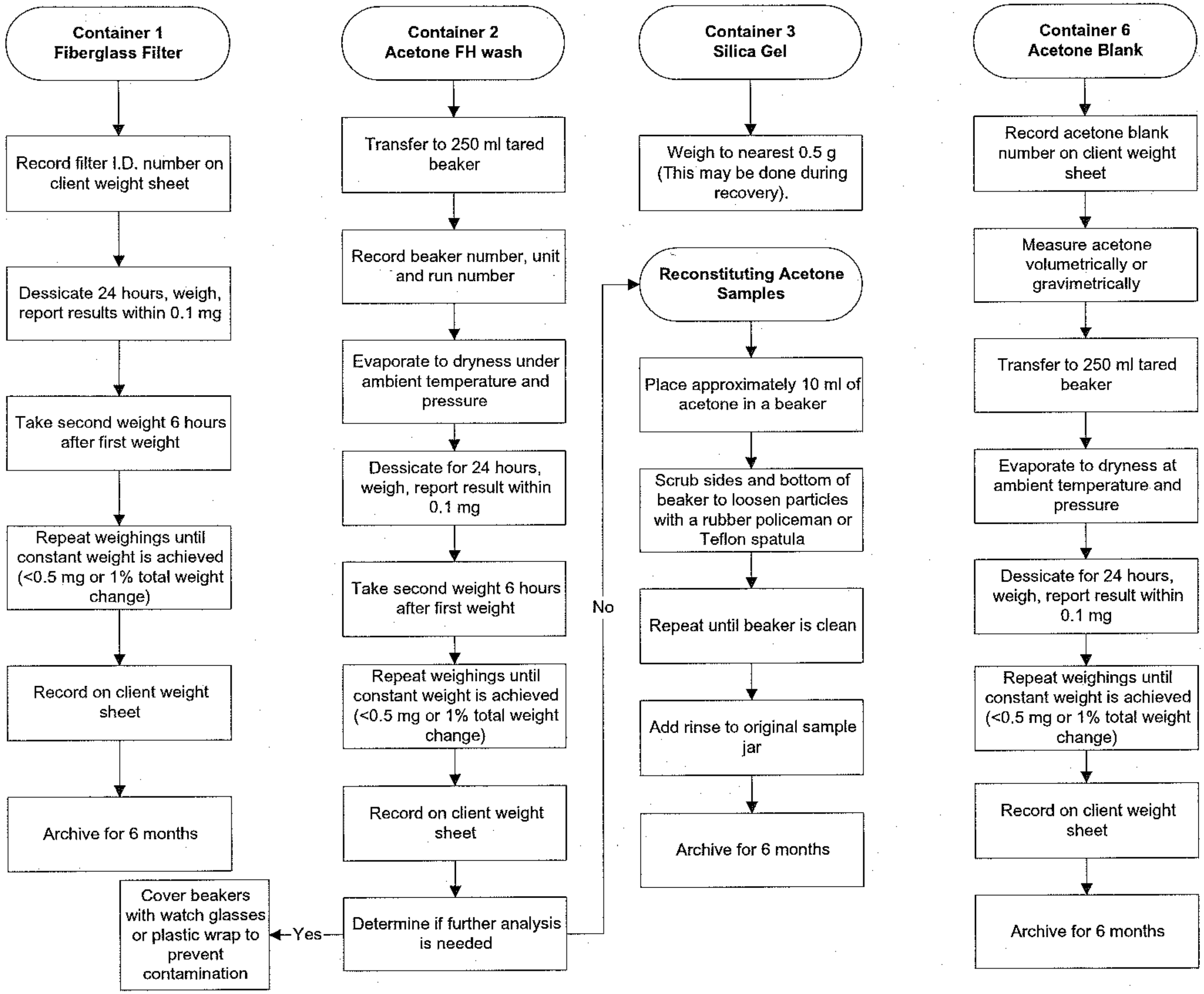
- 200 ml of acetone from rinse bottle. Record lot number

Container 7*
D.I. Water Blank
250 ml Plastic

- 200 ml of water from rinse bottle

*Containers 4 and 7 are required when the testing includes a back half analysis

EPA Method 5
Analytical Flowchart



Specification Sheet for EPA Method 17

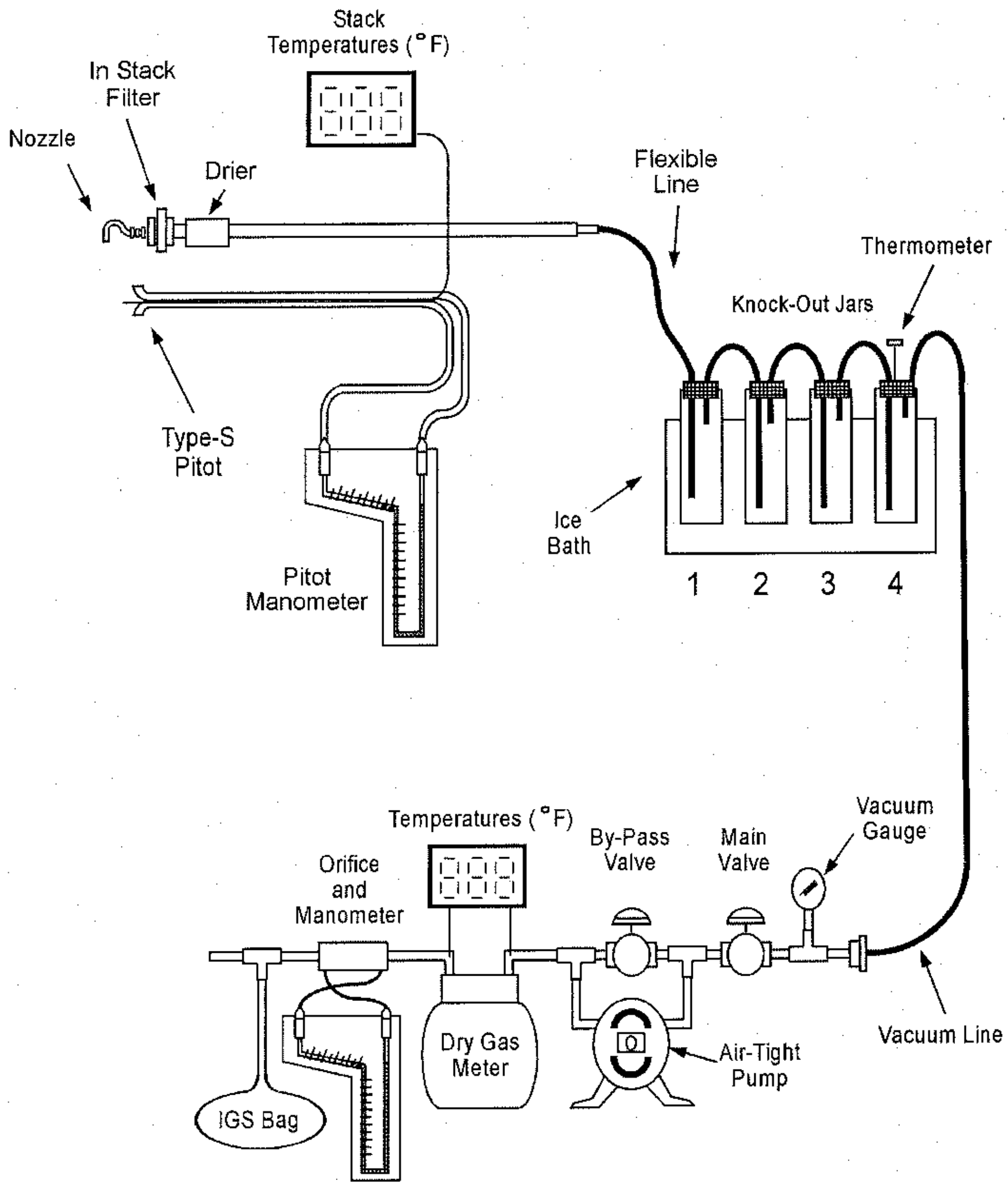
Source Location Name(s)	SCR Outlet
Pollutant(s) to be Determined	Particulate Matter (PM) - Particle Size
Other Parameters to be Determined from Train	Gas Density, Moisture

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	240 minutes
No. of Sample Traverse Points	N/A	48 points
Sample Time per Point	N/A	5 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Stainless Steel or Glass	Stainless Steel
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	N/A	Teflon
Effective Probe Length	N/A	6 feet
Probe Temperature Set-Point	N/A	Stack Temp
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.84
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Separate Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	In Stack	In-Stack
Filter Holder Material	Borosilicate, Quartz or Stainless Steel	Stainless Steel
Filter Support Material	Borosilicate, Quartz or Stainless Steel	Stainless Steel
Thimble Material	Glass Fiber (optional)	Stainless Steel
Filter Heater Set-Point	N/A	Stack Temp
Filter Material	Glass Fiber	Glass Fiber
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

Specification Sheet for EPA Method 17

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Leak-Free Glass Connectors	Rubber Hose to Metal Connecting Hardware
Connection to Probe or Filter by	Direct or Flexible Tubing	Flexible Rubber Line
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Modified Greenburg-Smith	Glass Bubbler
Impinger 2	Greenburg-Smith	Glass Bubbler
Impinger 3	Modified Greenburg-Smith	Glass Bubbler
Impinger 4	Modified Greenburg-Smith	Glass Bubbler
Impinger 5		
Impinger 6		
Impinger 7		
Impinger 8		
Gas Density Determination		
Sample Collection	Multi-point integrated	N/A
Sample Collection Medium	Flexible Gas Bag	N/A
Sample Analysis	Orsat or Fyrite Analyzer	N/A
Sample Recovery Information		
Nozzle Brush Material	Nylon Bristle	Nylon Bristle
Nozzle Rinse Reagent	Acetone	Acetone
Nozzle Rinse Wash Bottle Material	Glass or Polyethylene	Polyethylene
Nozzle Rinse Storage Container	Glass or Polyethylene	Glass
Filter Recovered?	Yes	Yes
Filter Storage Container	Glass or Polyethylene	Polystyrene
Impinger Contents Recovered?	No	No
Impinger Rinse Reagent	N/A	N/A
Impinger Wash Bottle	N/A	N/A
Impinger Storage Container	N/A	N/A
Analytical Information		
Method 4 H_2O Determination by	Volumetric or Gravimetric	Gravimetric and Volumetric
Filter Preparation Conditions	Dessicate 24 hours minimum at ambient temperature	Dessicate 24 hours minimum at ambient temperature
Front-Half Rinse Preparation	Evaporate at ambient temperature and pressure	Evaporate at ambient temperature and pressure
Back-Half Analysis	N/A	N/A
Additional Analysis	N/A	None

EPA Method 17
Sampling Train Configuration

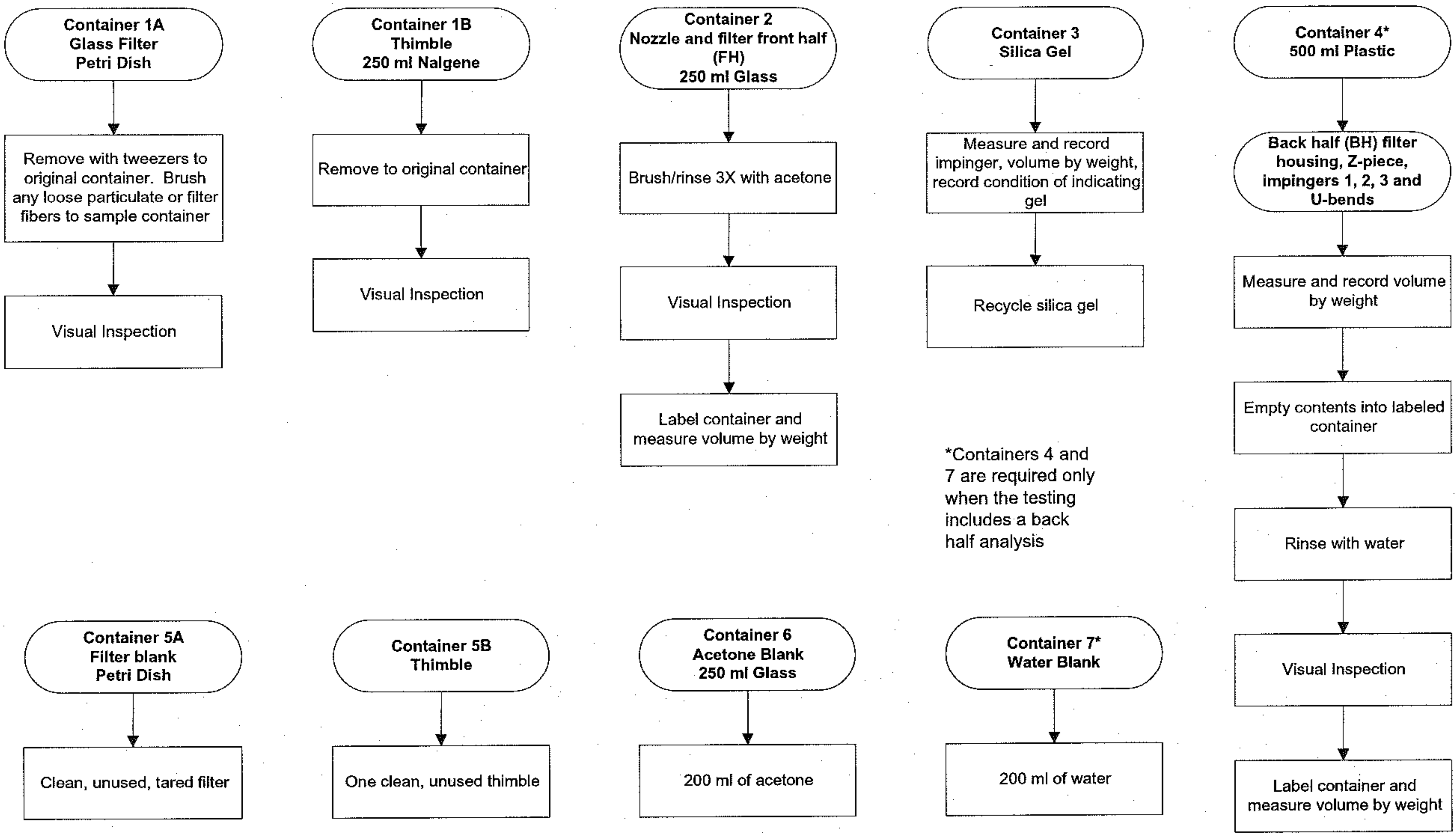


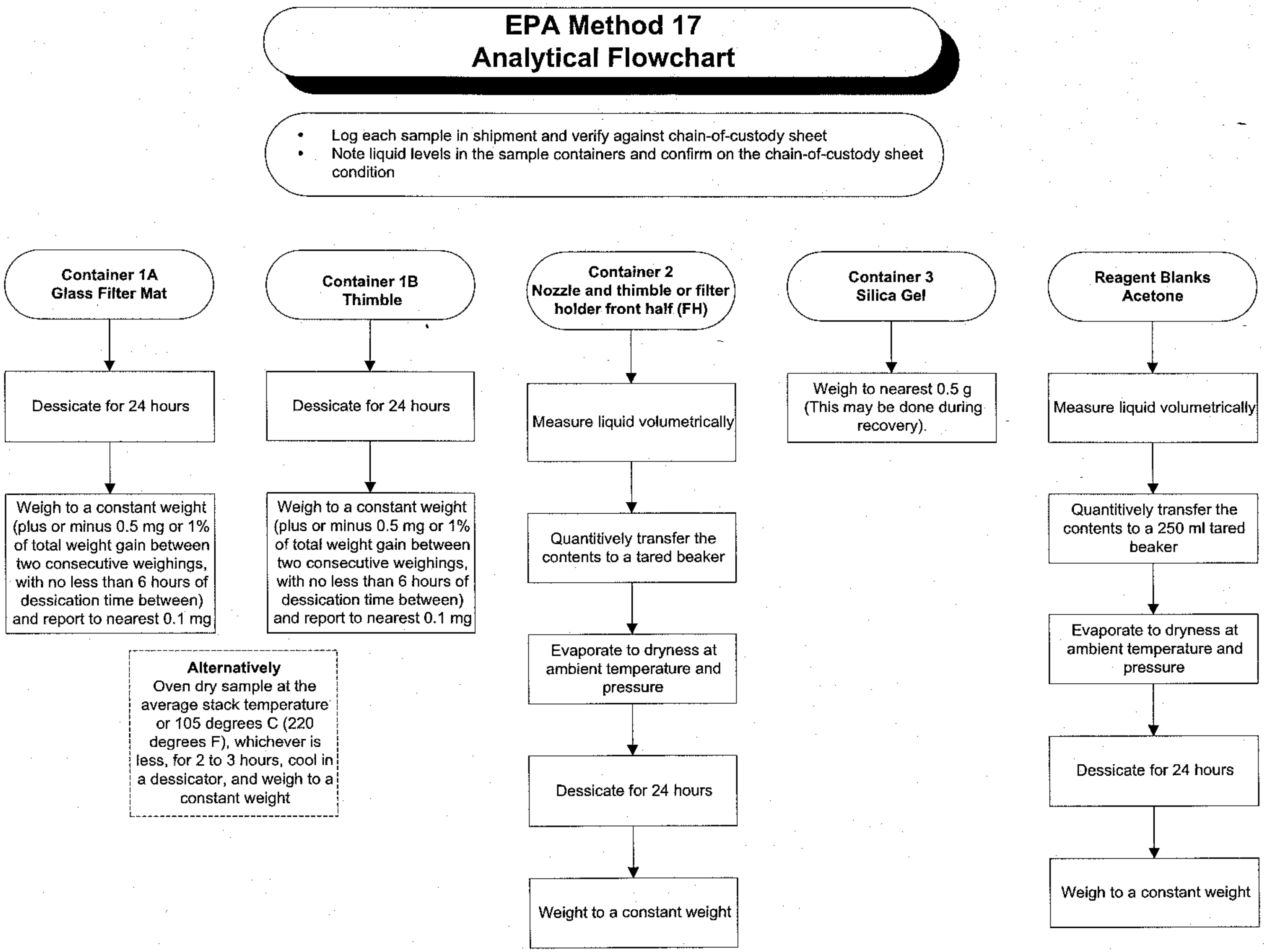
<u>Knock Out Jar Contents</u>

Impinger 1	100 ml H_2O
Impinger 2	100 ml H_2O
Impinger 3	Empty
Impinger 4	Silica Gel

EPA Method 17
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)




EPA Method 17
Analytical Flowchart
Log each sample in shipment and verify against chain-of-custody sheet
Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition
Container 1A
Glass Filter Mat
Dessicate for 24 hours
Weigh to a constant weight (plus or minus 0.5 mg or 1% of total weight gain between two consecutive weighings, with no less than 6 hours of dessication time between) and report to nearest 0.1 mg
Alternatively
Oven dry sample at the average stack temperature or 105 degrees C (220 degrees F), whichever is less, for 2 to 3 hours, cool in a dessicator, and weigh to a constant weight
Container 1B
Thimble
Dessicate for 24 hours
Weigh to a constant weight (plus or minus 0.5 mg or 1% of total weight gain between two consecutive weighings, with no less than 6 hours of dessication time between) and report to nearest 0.1 mg
Container 2
Nozzle and thimble or filter holder front half (FH)
Measure liquid volumetrically
Quantitively transfer the contents to a tared beaker
Evaporate to dryness at ambient temperature and pressure
Dessicate for 24 hours
Weight to a constant weight
Container 3
Silica Gel
Weigh to nearest 0.5 g (This may be done during recovery).
Reagent Blanks
Acetone
Measure liquid volumetrically
Quantitively transfer the contents to a 250 ml tared beaker
Evaporate to dryness at ambient temperature and pressure
Dessicate for 24 hours
Weigh to a constant weight

SAMPLE CALCULATIONS

B

A. Finkl and Sons
Clean Air Project No: 9939
Particulate Sampling

USEPA Method 5 (Particulate)
Sampling, Velocity and Moisture Sample Calculations

1. Volume of water collected (wscf)

$$V_{wstd} = (0.04707)(V_{lc})$$

Where:

Vlc	= total volume of liquid collected in impingers and silica gel (ml)	=	ml
0.04707	= ideal gas conversion factor (ft3 water vapor/ml or gm)	=	ft3/ml
Vwstd	= volume of water vapor collected at standard conditions (ft3)	=	ft3

2. Volume of gas metered, standard conditions (dscf)

$$V_{mstd} = \frac{(17.64)(V_m)\left(P_{bar} + \frac{\Delta H}{13.6}\right)(Y_d)}{(460 + T_m)}$$

Where:

Pbar	= barometric pressure (in. Hg)	=	in. Hg
Tm	= average dry gas meter temperature (°F)	=	°F
Vm	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=	dcf
Yd	= gas meter correction factor (dimensionless)	=	
ΔH	= average pressure drop across meter box orifice (in. H2O)	=	in. H2O
17.64	= standard temperature to pressure ratio (°R/in. Hg)	=	°R/in. Hg
13.6	= conversion factor (in. H2O/in. Hg)	=	in.H2O/in. Hg
460	= °F to °R conversion constant	=	°F
Vmstd	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	dscf

3. Sample gas pressure (in. Hg)

$$P_s = P_{bar} + \left(\frac{P_g}{13.6}\right)$$

Where:

Pbar	= barometric pressure (in. Hg)	=	in. Hg
Pg	= sample gas static pressure (in. H2O)	=	in. H2O
13.6	= conversion factor (in. H2O/in. Hg)	=	in. H2O/in. Hg
Ps	= absolute sample gas pressure (in. Hg)	=	in. Hg

4. Moisture measured in sample (% by volume)

$$B_{wo} = \frac{V_{wstd}}{\left(V_{mstd} + V_{wstd}\right)}$$

Where:

Vmstd	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	dscf
Vwstd	= volume of water collected at standard conditions (scf)	=	scf
Bwo	= proportion of water measured in the gas stream by volume	=	
		=	%

5. Nitrogen (plus carbon monoxide) in gas stream (% by volume, dry)

$$N_2 + CO = 100 - CO_2 - O_2$$

Where:

CO2	= proportion of carbon dioxide in the gas stream by volume (%)	=	%
O2	= proportion of oxygen in the gas stream by volume (%)	=	%
100	= conversion factor (%)	=	%
N2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	%

6. Molecular weight of dry gas stream (lb/lb·mole)

$$M_d = \left(M_{CO_2}\right)\frac{(CO_2)}{(100)} + \left(M_{O_2}\right)\frac{(O_2)}{(100)} + \left(M_{N_2+CO}\right)\frac{(N_2+CO)}{(100)}$$

Where:

MCO2	= molecular weight of carbon dioxide (lb/lb·mole)	=	lb/lb·mole
MO2	= molecular weight of oxygen (lb/lb·mole)	=	lb/lb·mole
MN2+CO	= molecular weight of nitrogen and carbon monoxide (lb/lb·mole)	=	lb/lb·mole
CO2	= proportion of carbon dioxide in the gas stream by volume (%)	=	%
O2	= proportion of oxygen in the gas stream by volume (%)	=	%
N2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	%
100	= conversion factor (%)	=	%
Md	= dry molecular weight of sample gas (lb/lb·mole)	=	lb/lb·mole

7. Molecular weight of sample gas (lb/lb·mole)

$$M_s = (M_d)(1 - B_w) + (M_{H_2O})(B_w)$$

Where:

Bw	= proportion of water vapor in the gas stream by volume	=	
Md	= dry molecular weight of sample gas (lb/lb·mole)	=	lb/lb·mole
MH2O	= molecular weight of water (lb/lb·mole)	=	lb/lb·mole
Ms	= molecular weight of sample gas, wet basis (lb/lb·mole)	=	lb/lb·mole

8. Velocity of sample gas (ft/sec)

$$V_s = (K_p)(C_P)\left(\sqrt{\Delta P}\right)\left(\sqrt{\frac{(T_s + 460)}{(M_s)(P_s)}}\right)$$

Where:

Kp	= velocity pressure constant	=	
Cp	= pitot tube coefficient	=	
Ms	= wet molecular weight of sample gas, wet basis (lb/lb·mole)	=	lb/lb·mole
Ps	= absolute sample gas pressure (in. Hg)	=	in. Hg
Ts	= average sample gas temperature (°F)	=	°F
√ΔP	= average square roots of velocity heads of sample gas (in. H2O)	=	√in. H2O
460	= °F to °R conversion constant	=	°F
Vs	= sample gas velocity (ft/sec)	=	ft/sec

9. Volumetric flow rate of sample gas at actual gas conditions (acfm)

$$Q_a = (60)(A_s)(V_s)$$

Where:

As	= cross sectional area of sampling location (ft2)	=	ft2
Vs	= sample gas velocity (ft/sec)	=	ft/sec
60	= conversion factor (sec/min)	=	sec/min
Qa	= volumetric flow rate at actual conditions (acfm)	=	acfm

10. Total flow of sample gas (scfm)

$$Q_s \quad = (Q_a)\left(\frac{P_s}{29.92}\right)\left(\frac{68+460}{T_s+460}\right)$$

Where:			
Qa	= volumetric flow rate at actual conditions (acfm)	=	acfm
Ps	= absolute sample gas pressure (in. Hg)	=	in. Hg
29.92	= standard pressure (in. Hg)	=	in. Hg
Ts	= average sample gas temperature (°F)	=	°F
68	= standard temperature (°F)	=	°F
460	= °F to °R conversion constant	=	
Qs	= volumetric flow rate at standard conditions, wet basis (scfm)	=	scfm

11. Dry flow of sample gas (dscfm)

$$Q_{std} \quad = (Q_s)(1-B_w)$$

Where:			
Bw	= proportion of water vapor in the gas stream by volume	=	
Qs	= volumetric flow rate at standard conditions, wet basis (scfm)	=	scfm
Qstd	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	dscfm

12. Percent isokinetic (%)

$$I \quad = \frac{(0.09450)\left(\overline{T_s}+460\right)(V_{mstd})}{(P_s)(V_s)\left(\frac{(D_n)^2(\pi)}{(144)(4)}\right)(\Theta)(1-B_w)}$$

Where:			
Dn	= diameter of nozzle (in)	=	in.
Bw	= proportion of water vapor in the gas stream by volume	=	
Ps	= absolute sample gas pressure (in. Hg)	=	in. Hg
Ts	= average sample gas temperature (°F)	=	°F
Vmstd	= volume of gas sample through the dry gas meter at standard conditions (dscf)	=	dscf
Vs	= sample gas velocity (ft/sec)	=	ft/sec
θ	= total sampling time (min)	=	min
0.0945	= conversion constant	=	
460	= °F to °R conversion constant	=	°F
I	= percent of isokinetic sampling (%)	=	%

Method 5D Flow Calculations

13. Velocity of sample gas at the outlet based on flow measurements at the inlet, Method 5D

$$v = \frac{Q_o}{A_o}$$

Where:

v	= sample gas average velocity (ft/sec)	=	ft/sec
Qo	= volumetric flow rate at outlet sample location (cfm)	=	cfm
Ao	= cross sectional area of outlet sampling location (ft2)	=	ft2

14. Total volumetric flowrate at the outlet, Method 5D

$$Q_O = Q_i + Q_d$$

Where:

Qo	= volumetric flow rate at outlet sample location (cfm)	=	cfm
Qi	= volumetric flow rate at the outlet (cfm)	=	cfm
Qd	= volumetric flow rate of dilution air (cfm)	=	cfm

15. Dilution air volumetric flowrate Method 5D

$$Q_d = \frac{Q_i\left(T_i + T_o\right)}{T_o - T_{amb}}$$

Where:

Qd	= volumetric flow rate of dilution air (cfm)	=	cfm
Qi	= volumetric flow rate at the outlet (cfm)	=	cfm
Ti	= average temperature of gas at inlet, (ºK)	=	ºK
To	= average temperature of gas at outlet, (ºK)	=	ºK
Tamb	= average ambient temperature, (ºK)	=	ºK

Particulate Sample Calculations

1. Particulate concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)$$

Where:

mn	= total particulate matter (g)	=	g
Vmstd	= volume metered, standard (dscf)	=	dscf
2.205 x 10-3	= conversion factor (lb/g)	=	lb/g
Csd	= particulate concentration (lb/dscf)	=	lb/dscf

2. Particulate concentration (gr/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(15.43)$$

Where:

mn	= total particulate matter (g)	=	g
Vmstd	= volume metered, standard (dscf)	=	dscf
15.43	= conversion factor (gr/g)	=	gr/g
Csd	= particulate concentration (gr/dscf)	=	gr/dscf

3. Particulate concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(1000)(35.31)$$

Where:

mn	= total particulate matter (g)	=	g
Vmstd	= volume metered, standard (dscf)	=	dscf
1,000	= conversion factor (mg/g)	=	mg/g
35.31	= conversion factor (dscf/dscm)	=	dscf/dscm
Csd	= particulate concentration (mg/dscm)	=	mg/dscm

5. Particulate rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)\left(Q_{std}\right)(60)$$

Where:

mn	= total particulate matter (g)	=	g
Vmstd	= volume metered, standard (dscf)	=	dscf
2.205 x 10-3	= conversion factor (lb/g)	=	lb/g
Qstd	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	dscfm
60	= conversion factor (min/hr)	=	min/hr
Elb/hr	= particulate rate (lb/hr)	=	lb/hr

SAMPLE DATA FIELD SHEETS

C

TEST LOCATION: ______________ ______________ **TESTING** METHOD: ______ PAGE ___ OF ___

UNIT: ________ RUN: ______

FIELD DATA SHEET

Client	Project No.
Plant	Date
Meter Operator	
Probe Operator	

Meter Box	Sample Box No.
Meter Y_d	Meter $\Delta H_@$
K Factor	Pitot C_p
Leak Rate Before [cfm] [Lpm]	@ (in. Hg)
Leak Rate After [cfm] [Lpm]	@ (in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)			
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	Bar. Press. _[in. Hg] [mbar]
Probe I.D. No.	
Liner Material	

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

Start Time:	Stop Time:

Traverse Point Number	Min/pt Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points	Filter T_f (°F)	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	XAD Trap Temp. T_t (°F)	Notes
	Total	*											
	Average												

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC______
Date

FDS005-General.xls, August 2004

METHOD 1 FIELD DATA SHEET

TEST LOCATION: ______________

UNIT: __________

Client		Project No.	
Plant		Date	
Duct Dimensions	(in.)	Area	(ft^2)
Port Length	(in.)	Port Diameter	(in.)
Equivalent Diameter (Rectangular Ducts) Deq=2LW/(L+W)			(in.)
Disturbance to Port Distance Upstream (A)			x D
Disturbance to Port Distance Downstream (B)			x D
Number of Points Required			
Number of Points / Port Required			

Point	% Diameter	Point Distance	Probe Mark
	Round Stacks Only	X	X + Port Depth

Location Schematic

Show side view of stack, including disturbances and port placement.

[N] [UP]

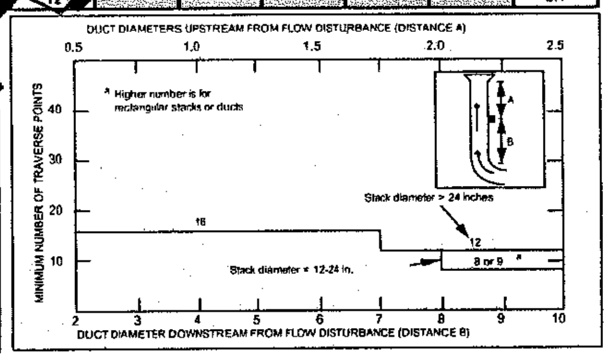
Traverse point number	Number of traverse points on a diameter					
	[illegible]	4	[illegible]	8	10	12
1	85[illegible]	[illegible]3.3	95.6	96.8	97.4	97.9
2	[illegible]	[illegible]	85.4	89.5	91.8	93.3
[illegible]		25.[illegible]	70.4	80.6	85.4	88.2
[illegible]		6.7	29.6	67.7	77.4	82.3
5			14.6	32.3	65.8	75.0
[illegible]			4.4	19.4	34.2	64.4
7				10.5	22.6	35.6
8				3.2	14.6	25.0
9					8.2	17.7
10					2.6	11.8
[illegible]						6.7
12						2.1

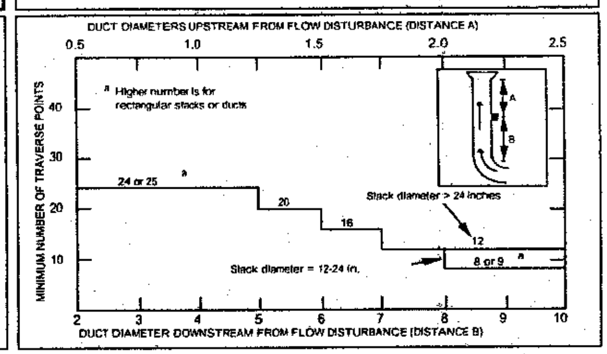
Location Schematic

Show cross-section of stack, indicating port placement.

[N] [UP]

Gas Flow
[IN] [OUT]
of page





Circle correct bracketed directions on diagrams.

QA/QC______

Date________

FDS001A-EPA1.xls, August 2004

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ORSAT READINGS

TEST LOCATION: ______________________ **PAGE** _____ **OF** _____

Client		Project Number		$Fo = \frac{20.9 - \%O_2}{\%CO_2}$
Plant		Unit		
Orsat ID		Fuel Type		Leak Check Passed ☐

Run Number	Method Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Fo	Analyst	Analysis	
								Date	Time
		1							
		2							
		3							
		Avg.							
		1							
		2							
		3							
		Avg.							
		1							
		2							
		3							
		Avg.							
		1							
		2							
		3							
		Avg.							
		1							
		2							
		3							
		Avg.							
		1							
		2							
		3							
		Avg.							

Repeat the analysis procedure until the results of any three analyses differ by no more than 0.2 percent by volume Average the three acceptable values and report the results to the nearest 0.1 percent. Calculate Fo to verify result

Acceptable ranges for Fo:

Coal:	Anthracite and lignite	1.016-1.130	Gas:	Natural	1.600-1.836
	Bituminous	1.083-1.230		Propane	1.434-1.586
Oil:	Distillate	1.260-1.413		Butane	1.405-1.553
	Residual	1.210-1.370	Wood:		1.000-1.120

QA/QC______
Date______

CleanAir ENGINEERING

TEST LOCATION: ________________

VELOCITY DETERMINATION
FIELD DATA SHEET

PAGE ___ **OF** ___

UNIT: ____________

Client	Project No.
Plant	Date
Meter Operator	
Probe Operator	
Source of Moisture and Molecular Weight Data	

Cross-Section of Test Location

[N] [UP]

Amb. Temp. (°F)	Bar. Press [in. Hg] [mbar]
Pitot Cp	Probe I.D. No.
Duct Diameters from Disturbance	
Downstream	Upstream
First point all the way [In] [Out]	Port Len. (in.)
Gas flow [In] [Out] of page	
Duct Dimensions (in.)	

Run	Load			Run	Load			Run	Load			Run	Load		
Start Time	Stop Time			Start Time	Stop Time			Start Time	Stop Time			Start Time	Stop Time		
Static Press. (in. H_2O)				Static Press. (in. H_2O)				Static Press. (in. H_2O)				Static Press. (in. H_2O)			
Post-Test Leak Check:		Pass ☐	Fail ☐	Post-Test Leak Check:		Pass ☐	Fail ☐	Post-Test Leak Check:		Pass ☐	Fail ☐	Post-Test Leak Check:		Pass ☐	Fail ☐
Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes	Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes	Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes	Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
Total		*				*				*				*	
Average															

* Sum of square roots. Circle correct bracketed units on data sheet.

QA/QC______

Date________

CleanAir ENGINEERING

FDS002-Velocity.xls, August 2004